California Rice Commission
Algae Aquatic Toxicity Management Plan

2010

Final, April 27, 2010

Introduction

Since 2004, the California Rice Commission (CRC) has implemented water quality monitoring and reporting pursuant to the Monitoring and Reporting Programs (MRP) approved by the Central Valley Regional Water Quality Control Board (CVRWQCB) and administered under the CVRWQCB's Irrigated Lands Program (ILP). Monitoring results are reviewed and reported annually in the CRC's Annual Monitoring Report.

The ILP includes requirements of CVRWQCB Resolution No. R5-2006-0077, which specifies that management plans are required when ILP monitoring results show two or more observed "exceedances" at a site over a three-year period.

Results of aquatic toxicity tests performed under the CRC's ILP monitoring showed statistically significant reductions in algae growth (*Selenastrum capricornutum*), as compared to a control sample, and triggered the development and implementation of an Algae Management Plan (AMP). The CRC implemented AMPs in 2007, 2008, and 2009. Each progressive AMP sought to focus and refine the technical monitoring and assessment approach to determine if products used by rice growers cause or contribute to algae reductions.

Background

California rice growers are required to use pesticides in accordance with pesticide label requirements and county-specific pesticide use requirements. Label requirements are developed by the U.S. Environmental Protection Agency and/or the California Department of Pesticide Regulation in consideration of pesticide fate and transport characteristics and aquatic toxicity, among other factors, and management practices such as water holds and mandated reporting are specified to be protective of receiving water quality.

Selenastrum capricornutum is the algae specified by the US Environmental Protection Agency (EPA) to determine chronic aquatic toxicity of receiving waters[1]. The aquatic toxicity tests are performed on samples collected at each station and are performed concurrent with tests on control samples.

The approach to monitoring and assessment of algae toxicity has been adjusted and refined in attempts to better hone in on identification of causal agents. Table 1 briefly summarizes the evolution of the initial (2005-2006) monitoring and assessment and the subsequent approach required in the AMPs. Table 2 lists the sites that have been included in CRC algae

[1] USEPA. 2002. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, 4th Edition. EPA-821-R-02-013.

monitoring and assessment efforts. Continual refinements taken place in order to attempt to better address the primary question of whether rice management practices are contributing to or causing algae reductions. The following general questions have been used to guide the refinement of the efforts:

- Are there seasonal patterns of algae reductions?
- Are there sites that consistently show algae reductions?
- Are rice pesticides or copper concentrations detected concurrent with algae reductions?

TABLE 1
Elements included in CRC Algae Toxicity Monitoring and Assessment, 2005 through 2009

Monitoring and Assessment Element	2005-2006	2007[a]	2008	2009	
Algae Toxicity Testing of Initial Sample	✓	✓	✓ [b]	✓ [c]	Basic requirement of assessment monitoring regimes.
Resampling triggered if observed reduction was >50% of control sample	✓	✓	✓	✓	Basic requirement of assessment monitoring regimes that include algae toxicity testing.
TIEs required to be performed on resample if algae toxicity test showed statistically significant reduction as compared to the control sample	✓				Initial requirement of the original ILP monitoring requirements.
TIEs not required; herbicides analysis conducted in lieu		✓	✓	✓	TIEs had proven inconclusive and it was determined that pesticide analysis conducted concurrent with algae toxicity tests could assist in identifying potential toxicant.
Herbicide analysis required if algae toxicity test showed statistically significant reduction as compared to the control sample		✓			
Herbicide analysis of initial sample (regardless of toxicity result) for selected monitoring events			✓	✓	This approach eliminated the sample degradation that was inherent to the approach used in 2007.

[a] Switched to a different lab in 2007, since results in 2006 did not meet acceptability criteria for control samples.
[b] Five main sites April through October
[c] Four main sites May through July; three assessment sites April through October

TABLE 2
Sites that have been included in CRC Algae Management Plan Monitoring

Site Code	Site Name	Latitude	Longitude	Site Type
CBD1	Colusa Basin Drain above Knights Landing	38.8125 N	-121.7731 W	Main
CBD5	Colusa Basin Drain #5	39.1833 N	-122.0500 W	Main
BS1	Butte Slough at Lower Pass Road	39.1875 N	-121.9000 W	Main
SSB	Sacramento Slough Bridge near Karnak	38.7850 N	-121.6533 W	Main
JS	Jack Slough at Jack Slough Road (near Kimball Lane)	39.1804 N	-121.5711 W	Rotating
F	Lurline Creek; upstream site of CBD5	39.2184 N	-122.1512 W	Assessment
G	Cherokee Canal; upstream site for BS1*	39.3611 N	-121.8675 W	Assessment
H	Obanion Outfall at DWR PP on Obanion Rd.	39.0258 N	-121.7272 W	Assessment

Description of Monitoring and Assessment Refinements

The following describes the evolution of the approach to monitoring and assessment of algae toxicity.

2005 Monitoring and Assessment

- Resampling was triggered if algae toxicity tests showed a reduction, as compared to the control.
- If resample was found to result in statistically significant algae reductions, TIEs were to be conducted on resample.

2006 Refinements

- Resampling was triggered if algae toxicity tests showed growth of less than 50% as compared to the control.
- TIEs were to be performed on resamples if resamples showed aquatic toxicity.
- The approach outlined in the MRP called for analysis of the TIE elute for a prescribed list of pesticides, following the conclusion of the TIE.

2007 Refinements

- Resampling continued to be triggered if algae toxicity tests showed a reduction of 50%, as compared to the control.
- The AMP focused additional sample collection for and times where reductions had previously been observed. This included collection of sufficient sample volume at CBD1 in July and BS1, CBD5 and SSB in September to conduct herbicides analysis if toxicity was detected at these events.

- The list of herbicides was developed to encompass rice herbicides, as well as several products that are not used on rice but that had been detected in earlier RWQCB/UC Davis pesticides sampling. These products are listed in Table 3.
- TIEs were not required.

2008 Refinements

- Resampling continued to be triggered if algae toxicity tests showed a reduction of 50%, as compared to the control.
- Analysis of pesticides was performed concurrent with algae toxicity testing, and regardless of the result of the algae toxicity test.
- The same list of herbicides was used as in 2007. These products are listed in Table 3.
- TIEs not required.

2009 Refinements

- Resampling continued to be triggered if algae toxicity tests showed a reduction of 50%, as compared to the control.
- Algae toxicity testing was to be conducted at core sites during the months of May, June, and July. These months correspond to peak rice pesticide use and were the months indicated by analysis of the 2008 results.
- As in 2008, analysis of pesticides was performed concurrent with algae toxicity testing, and regardless of the result of the algae toxicity test.
- The list of herbicides was refined to a subset of only pesticides detected in previous monitoring (and the specified pesticides). These products are listed in Table 3.

TABLE 3
Pesticides Analyzed Under CRC Algae Monitoring and Assessment Efforts

Active Ingredient	EPA Method	2007	2008	2009
Atrazine	8141A	X	X	
Azoxystrobin [a]	8141A	X	X	
Bensulfuron-methyl	8081A	X	X	
Bispyribac-sodium	8151A(m)	X	X	
Carfentrazone-ethyl	8081A	X	X	X
Clomazone	8141A	X	X	X
Cyhalofop-butyl	8081A	X	X	
Diuron [b]	632	X	X	
Glyphosate	547	X	X	X
Halosulfuron-methyl	8081A	X	X	
Molinate	8141A	X	X	
Pendimethalin [b]	8081A	X	X	X
Penoxsulam	632	X	X	X
Propanil [b]	8081A	X	X	

TABLE 3
Pesticides Analyzed Under CRC Algae Monitoring and Assessment Efforts

Active Ingredient	EPA Method	2007	2008	2009
Propiconazole [a]	8141A	X	X	
Simazine [b]	8141A	X	X	
Thiobencarb [b]	8141A	X	X	
Triclopyr TEA	8151A	X	X	X
Trifloxystrobin [a]	8081A	X	X	

[a] Fungicides

[b] Detected in 2005 UC Davis monitoring, concurrent with observed *Selenastrum* reductions (although TIEs performed on sample did not conclude that these products were the causative agents)

Results Summary

This summary focuses on the results of algae toxicity testing and associated pesticides and copper analysis for the period 2007 through 2009. These three years of data were collected under algae management plans, and the algae toxicity testing was performed at AQUASCIENCES lab during all three of these years. The following summarizes the results of these AMPs. The summary results for algae toxicity tests performed during this period are shown in Table 4.

TABLE 4
Summary of Algae Toxicity Tests, 2007 - 2009

	Number of Statistically Significant Reductions in Algae Growth (as compared to control)		
Month	**2007**	**2008**	**2009**
February	2	-	-
March	-	0	-
April	2	3	1
May	3	5	2
June	7	2	0
July	3	0	0
August	0	1	0
September	1	0	0
October	0	0	-
Number of Tests Showing Statistically Significant Reductions in Algae Growth	**18**	**11**	**3**
Total Number of Algae Toxicity Tests (Samples & Resamples)	38	39	30
% of Tests Showing Statistically Significant Reductions	47%	28%	10%

2007 Monitoring and Assessment

The following monitoring and assessment was conducted in 2007:

- Monthly samples were collected at four main sites (BS1, CBD1, CBD5, SSB) and one rotating site (JS), during the months of February and April through September.
- Samples collected April through September were analyzed for the specified pesticides monitored as part of the annual monitoring program: cyhalofop-butyl azoxystrobin propiconazole and trifloxystrobin.
- As part of the 2007 AMP, the list of pesticides shown in Table 3 was analyzed as follows: July (CBD1), September (BS1, CBD5, and SSB).

Algae toxicity test results from the 2007 season are shown in Table 5. During the 2007 monitoring season, a total of 38 algae toxicity tests were conducted on samples and resamples collected at four main sites (BS1, CBD1, CBD5, SSB) and one rotating site (JS). The following summarizes these results:

- Five samples (13%) showed statistically significant algae reductions with growth less than 50% as compared to the control, with percent growth as compared to the control ranging from 8% to 36%. These results occurred in May (SSB, primary sample) and June (CBD1 and SSB, primary sample and resample).
- Another three samples (8%) collected during 2007 [May (CBD1), June (JS), September (SSB)] showed growth of between 50% - 70% as compared to the control.
- The remaining 30 samples (79%) showing growth above 70% as compared to the control.
- All samples evaluated in August showed growth in excess of the control.
- On a site-to-site comparison, CBD1 and SSB results included the most statistically significant reductions (6 of 8, and 5 of 9, respectively).
- A month-to-month comparison shows May, June, and July as the months with the most statistically significant reductions (3 of 6, 7 of 7, and 3 of 5, respectively).
- Of the specified pesticides, only azoxystrobin was detected. A concentration of 2.67 ug/L was detected at JS concurrent with a statistically significant growth of 95% as compared to the control, and a concentration of 1.26 ug/L was detected at CBD1 concurrent with a statistically significant growth of 89% as compared to the control. The data from the ECOTOX database indicate a 120-hr EC50 (POP ABND) Pseudokirchneriella subcapitata (green algae) of 106 ug/L for azoxystrobin. The measured results are two orders of magnitude less than this EC50 value, so the algae reductions are not readily attributable to azoxystrobin. Further, greater growth is attributed to the sample with the higher azoxystrobin concentration.
- Results for the specified pesticides and additional herbicides (Table 3) analyzed performed on the BS1, CBD1, CBD5, and SSB samples as part of the CRC's Selenastrum study plan were all non-detect. Detection limits were determined to be at least one order of magnitude less than toxicity values identified through a search of the ECOTOX database.

- Copper (total copper) and hardness analysis was performed at CBD1 in July and at BS1, CBD5, and SSB in September.
- Evaluation of the herbicides detections concurrent with the algae toxicity results does not indicate a specific toxicant.

TABLE 5
2007 Algae Toxicity Test Results

Month	Sampling Dates	Selanastrum 96-Hour Survival % Survival, as compared to control					Statistically significant toxicity? (based on % survival)				
		BS1	CBD1	CBD5	JS	SSB	BS1	CBD1	CBD5	JS	SSB
February	2/27/2007	97%	**76%**	**79%**	110%	119%	No	Yes	Yes	No	No
April	4/24/2007	**86%**	**85%**	91%	97%	96%	Yes	Yes	No	No	No
May	5/8/2007	**84%**	**67%**	99%	98%	**28%**	Yes	Yes	No	No	Yes
	5/16/2007 (RS)	-	-	-	-	94%	-	-	-	-	No
June	6/5/2007	**86%**	**25%**	**79%**	**66%**	**8%**	Yes	Yes	Yes	Yes	Yes
	6/12/2007 (RS)	-	**8%**	-	-	**36%**	-	Yes	-	-	Yes
July	7/10/2007	100%	**86%**	100%	**80%**	**74%**	No	Yes	No	Yes	Yes
August	8/21/2007	125%	109%	118%	105%	115%	No	No	No	No	No
September	9/18/2007	88%	89%	94%	95%	**70%**	No	No	No	No	Yes

(RS) – indicates that this event was a resample event triggered by results of the previous sampling event
Yellow highlight indicates a result of growth <50% as compared to the control
Pink border indicates that a resample was triggered by the result.

TABLE 6
2007 Herbicides, Fungicides and Copper Results

Date & Location	Pesticide Hits? (conc, ug/L)	Algae Tox (% survival as compared to the control)	Total Copper Conc	1 Hr Ave Tox Copper Conc Exceeded?
Pesticides tested incl: azoxystrobin, propiconazole, cyhalofop butyl, trifloxystrobin				
February				
BS1	-	97%		
CBD1	-	76%		
CBD5	-	79%		
JS	-	110%		
SSB	-	119%		
April				
BS1	ND	86%		
CBD1	ND	85%		
CBD5	ND	91%		
JS	ND	97%		
SSB	ND	96%		
May				
BS1	ND	84%		
CBD1	ND	67%		
CBD5	ND	99%		
JS	ND	98%		
SSB	ND	28%		
June				
BS1	ND	86%		
CBD1	ND	25%		
CBD5	ND	79%		
JS	ND	66%		
SSB	ND	8%		
July				
BS1	ND	100%		
CBD1	ND [1]	86%	ND	No
CBD5	ND	100%		
JS	ND	80%		
SSB	ND	74%		
August				
BS1	ND	125%		
CBD1	ND	109%		
CBD5	ND	118%		
JS	ND	105%		
SSB	ND	115%		
September				
BS1	ND [1]	88%	ND	No
CBD1	Azoxystrobin 1.26	89%		
CBD5	ND [1]	94%	ND	No
JS	Azoxystrobin 2.67	95%		
SSB	ND [1]	70%	ND	No

October				
BS1	-	100%		
CBD1	-	105%		
CBD5	-	115%		
JS	-	102%		
SSB	-	104%		

[1] This sample was analyzed for the list of analytes shown in Table 3, in addition to azoxystrobin, propiconazole, cyhalofop butyl, trifloxystrobin.
Blue highlight indicates statistically significant reduction in growth as compared to the control.

2008 Monitoring and Assessment

The following monitoring and assessment was conducted in 2008:

- Monthly samples were collected at four main sites (BS1, CBD1, CBD5, SSB) and one rotating site (JS), during the months of April through October. A sample was also collected at JS in March.
- Samples collected March through September were analyzed for atrazine, azoxystrobin, bensulfuron-methyl, bispyribac sodium, carfentrazone, clomazone, cyhalofop butyl, diuron, glyphosate, halosulfuron methyl, molinate, pendimethalin, penoxsulam, propanil, propiconazole, simazine, thiobencarb, triclopyr TEA, and trifloxystrobin (Table 3).

Algae toxicity test results from the 2008 season are shown in Table 7. During the 2008 monitoring season, a total of 40 algae toxicity tests were conducted on samples and resamples collected at four main sites (BS1, CBD1, CBD5, SSB) and one rotating site (JS). The following summarizes these results:

- Four samples (10%) showed statistically significant algae reductions with growth less than 50% as compared to the control, with percent growth as compared to the control ranging from 10% to 55%. These results occurred in May (CBD1, CBD5, SSB, primary sample) and June (JS, primary sample).
- Another two samples (5%) collected during 2008 [April (JS and SSB)] showed growth of between 50% - 70% as compared to the control.
- The remaining 34 samples (85%) showing growth above 70% as compared to the control.
- A site-to-site comparison does not reveal any particular trend.
- A month-to-month comparison shows May as the month with the most statistically significant reductions (5 of 8, including resamples).
- Of the analyzed pesticides (Table 3), the following were detected: propanil, triclopyr, clomazone, azoxystrobin.
- The following comparisons to aquatic toxicity values from USEPA ECOTOX database can be used to assess if the materials are indicated for additional monitoring. These values are the lowest values identified for a green algae species

through a search of the ECOTOX database performed in 2008. These values are not regulatory thresholds.

- As compared to a 29 ug/L 120-hr EC50 (POP ABND) Pseudokirchneriella subcapitata (green algae) for propanil, the single detection of propanil (1.94 ug/L) is an order of magnitude less than the EC50.
- As compared to a 5,900 ug/L 168-hr EC50 for triclopyr, the highest detection of triclopyr (3.35 ug/L) is three orders of magnitude less than the EC50.
- As compared to a 3,500 ug/L 120-hr EC50 (POP ABND) Pseudokirchneriella subcapitata (green algae) for clomazone, the highest detection of clomazone (1.74 ug/L) is three orders of magnitude less than the EC50.
- As compared to a 106 ug/L 120-hr EC50 (POP ABND) Pseudokirchneriella subcapitata (green algae) for azoxystrobin, the highest detection of azoxystrobin (0.87ug/L) is two orders of magnitude less than the EC50.

- Evaluation of the herbicides detections concurrent with the algae toxicity results does not indicate a specific toxicant.

TABLE 7
2008 Algae Toxicity Test Results

Month	Sampling Dates	Selanastrum 96-Hour Survival % Survival, as compared to control					Statistically significant toxicity? (based on % survival)				
		BS1	CBD1	CBD5	JS	SS1	BS1	CBD1	CBD5	JS	SS1
March	3/12/2008	-	-	-	92%	-	-	-	-	N	-
April	4/29/2008	84%	**77%**	111%	**52%**	**69%**	N	**Yes**	N	**Yes**	**Yes**
May	5/13/2008	**74%**	**12%**	**50%**	**44%**	**71%**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
	5/29/2008 (RS)	-	102%	114%	98%	-	-	N	N	N	-
June	6/3/2008	103%	87%	**85%**	**10%**	91%	N	N	**Yes**	**Yes**	N
	6/12/2008 (RS)	-	-	-	111%	-	-	-	-	N	-
July	7/1/2008	121%	104%	118%	110%	124%	N	N	N	N	N
August	8/26/2008	105%	115%	107%	**77%**	115%	N	N	N	**Yes**	N
September	9/16/2008	116%	125%	115%	97%	109%	N	N	N	N	N
October	10/21/2008	96%	104%	93%	88%	103%	N	N	N	N	N

(RS) – indicates that this event was a resample event triggered by results of the previous sampling event
Yellow highlight indicates a result of growth <50% as compared to the control
Pink border indicates that a resample was triggered by the result.

TABLE 8
2008 Herbicides, Fungicides and Copper Results

Date & Location	Pesticide Hits? (conc, ug/L)	Algae Tox (% survival as compared to the control)	Copper Conc	1 Hr Ave Tox Copper Conc Exceeded?
Pesticides tested incl: atrazine, azoxystrobin, bensulfuron-methyl, bispyribac sodium, carfentrazone, clomazone, cyhalofop butyl, diuron, glyphosate, halosulfuron methyl, molinate, pendimethalin, penoxsulam, propanil, propiconazole, simazine, thiobencarb, triclopyr TEA, and trifloxystrobin				
March				
JS	ND	92%	6.7	No
June				
BS1	Propanil 1.94	103%	12	No
CBD1	Triclopyr 0.14	87%	7.7	No
CBD5	Clomazone 1.13, Triclopyr 0.29	85%	11	No
SSB	Clomazone 1.74	91%	4.6	No
July				
CBD1	Triclopyr 3.35	104%	6.3	No
Sept				
BS1	Azoxystrobin 0.87	116%	2.9	No
CBD5	Azoxystrobin 0.53, Triclopyr 0.35	93%	4.8	No
SSB	Azoxystrobin 0.63, Triclopyr 0.33	103%	3.5	No

2009 Monitoring and Assessment

The following monitoring and assessment was conducted in 2009:

- Monthly samples were collected at four main sites (BS1, CBD1, CBD5, SSB) during May thorough July and three assessment sites (F, G, H) during the months of April through September.

Algae toxicity test results from the main sites during 2009 season are shown in Table 9, and results from the assessment sites are shown in Table 10. During the 2009 monitoring season, a total of 30 algae toxicity tests were conducted on samples were analyzed. The following summarizes these results:

- No samples (0%) showed statistically significant algae reductions with growth less than 50% as compared to the control.
- No samples (0%) collected during 2009 [April (JS and SSB)] showed growth of less than 84%.
- All 30 samples (100%) showing growth above 70% as compared to the control.
- Three samples showed statistically significant reduction in growth as compared to the control [April (G), May (CBD1 and SSB)].
- A site-to-site comparison does not reveal any particular trend.

- A month-to-month comparison shows May as the month with the most statistically significant reductions (2 of 5).
- Significant growth as compared to the control was identified in 27 (90%) of the samples.
- Of the analyzed pesticides (Table 3), the following were detected: clomazone, propanil, and triclopyr.
- The following comparisons to aquatic toxicity values from USEPA ECOTOX database can be used to assess if the materials are indicated for additional monitoring. These values are the lowest values identified for a green algae species through a search of the ECOTOX database performed in 2008. These values are not regulatory thresholds.
    - As compared to a 29 ug/L 120-hr EC50 (POP ABND) Pseudokirchneriella subcapitata (green algae) for propanil, the highest detection of propanil (47 ug/L) is the same order of magnitude as the EC50. However, it is noted that there was statistically significant algae growth observed in the sample corresponding to this result. This indicates that a concentration of 47 ug/L in this sample did not cause reductions in algae growth.
    - As compared to a 5,900 ug/L 168-hr EC50 for triclopyr, the single detection of triclopyr (0.71 ug/L) is four orders of magnitude less than the EC50. This detection was concurrent with a sample demonstrating statistically significant algae growth as compared to the control. In addition, this detection occurred concurrent with detections of clomazone and propanil, showing that these three herbicides in these concentrations did not impair growth of algae in the sample.
    - As compared to a 3,500 ug/L 120-hr EC50 (POP ABND) Pseudokirchneriella subcapitata (green algae) for clomazone, the highest detection of clomazone (6.9 ug/L) is three orders of magnitude less than the EC50. This detection was concurrent with a sample demonstrating statistically significant algae growth as compared to the control.
- Evaluation of the herbicides detections concurrent with the algae toxicity results does not indicate a specific toxicant.

TABLE 9
2009 Algae Toxicity Test Results, Main Sites

Month	Sampling Dates	Selanastrum 96-Hour Survival % Survival, as compared to control					Statistically significant toxicity? (based on % survival)				
		BS1	CBD1	CBD5	JS	SS1	BS1	CBD1	CBD5	JS	SS1
April	4/28/2009	-	-	-	NA	-	-	-	-	NA	-
May	5/12/2009 (assessment), 5/13/2009 (core)	102%	**84%**	108%	NA	**88%**	N	**Yes**	N	NA	**Yes**
June	6/2/2009 (core), 6/3/2009	245%	162%	355%	NA	176%	N	N	N	NA	N

	(assessment)										
July	7/7/2009 (core), 7/8/2009 (assessment)	511%	373%	679%	NA	145%	N	N	N	NA	N
August	8/25/2009	-	-	-	NA	-	-	-	-	NA	-
September	9/15/2009	-	-	-	NA	-	-	-	-	NA	-

TABLE 10
2009 Algae Toxicity Test Results, Assessment Sites

Month	Sampling Dates	Selanastrum 96-Hour Survival % Survival, as compared to control			Statistically significant toxicity? (based on % survival)		
		F	G	H	F	G	H
April	4/28/2009	100%	**85%**	101%	N	Yes	N
May	5/12/2009 (assessment), 5/13/2009 (core)	109%	100%	102%	N	N	N
June	6/2/2009 (core), 6/3/2009 (assessment)	198%	426%	656%	N	N	N
July	7/7/2009 (core), 7/8/2009 (assessment)	1056%	853%	526%	N	N	N
August	8/25/2009	605%	225%	408%	N	N	N
September	9/15/2009	480%	306%	270%	N	N	N

TABLE 11
2009 Herbicides and Copper Results

Date & Location	Pesticide Hits? (conc, ug/L)	Algae Tox (% survival as compared to the control)	Total Copper Conc	1 Hr Ave Tox Copper Conc Exceeded?
Pesticides tested incl: clomazone, carfentrazone ethyl, glyphosate, pendimethalin, penoxsulam, and triclopyr and propanil (during certain events)				
April				
BS1	Clomazone 0.39	-	3.9	No
CBD5	Clomazone 0.51	-	8.6	No
G	Clomazone 0.75	85%	4.2	No
F	Clomazone 0.23	100%	35	Yes
May				
BS1	Clomazone 2.3	102%	4.8	No
CBD5	Clomazone 6.9	108%	10	No
CBD1	Clomazone 2.8	84%	4	No

SSB	Clomazone 1.74	88%	3.5	No
H	Clomazone 0.84	102%	3.8	No
G	Clomazone 2.5	100%	17	Yes
F	Clomazone 5.6	109%	26	Yes
June				
BS1	Clomazone 2.5	245%	7.6	No
CBD5	Clomazone 2.6, Propanil 1.9, Triclopyr 0.71	355%	11	No
CBD1	Clomazone 4.0	162%	8.2	No
SSB	Clomazone 1.8	176%	5.5	No
H	Clomazone 3.8	656%	5.8	No
G	Clomazone 2.9	326%	6.6	No
F	Propanil 47	198%	11	No
July				
CBD5	Propanil 0.38	679%	6.4	No
CBD1	Propanil 0.065	373%	5.5	No
SSB	Propanil 0.25	145%	5.3	No

Conclusions and Proposals

A robust suite of herbicides was evaluated in 2007 and 2008. The selection of the suite of pesticides was based on previous TIE determinations that indicated a non-polar organic herbicide as a potential toxicant contributing to reductions of algae growth in samples, as compared to the control. Rice herbicides were included in this suite of pesticides, as well as some non-rice-specific products (e.g. atrazine, simazine), other high-use products not registered for use on rice (e.g. diuron) and fungicides used on rice as well as other crops (azoxystrobin, propiconazole, trifloxystrobin), and copper. The suite was refined in 2009 to include previously detected herbicides. The results of these analyses found that most of these products were not present in sampled waters. Where there were detections, the concentrations were at levels well below (at least one order of magnitude) EC50 values indicated by the literature contained in ECOTOX.

The following conclusions can be made from these data:

- Clomazone, though detected in the highest frequency, is not implicated in algae reductions. The detections of clomazone are well below the ECOTOX values.
- Propanil does not appear to be indicated in observed toxicity, based on available data. One detection of propanil at concentration the same order of magnitude as the ECOTOX value showed growth in algae, as compared to the control.
- The frequency and magnitude of algae reductions show a general downward trend. 2009 results were improved relative to previous years, both in terms of the number of statistically significant reductions and the magnitude of the reductions.

The following proposals are made for the 2010 program:

- Commence monitoring under a core monitoring program regime, and suspend additional algae toxicity testing and herbicides analysis under an AMP. Though

AMP results do not indicate additional propanil monitoring, it is noted that the CRC intends to conduct monitoring of propanil under a propanil management plan.

- Under the assessment phase, three species toxicity testing and herbicides screening at main and assessment sites would recommence. This requirement is based on the General MRP requirements.
- Recommend that the algae toxicity testing needs further review in the Region 5 when funding sources become available for the CVRWQCB to contract the resources necessary to complete the task.